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(54) Optical disk apparatus.

(57) The invention is intended to digitize a first signal, reproduce or record and reproduce the digital information compressed in band up to a specified bit rate A1 at a specified rotating speed K or specified linear velocity V, digitize a second signal, reproduce or record and reproduce the digital information compressed in band up to a specified bit rate A2 at a rotating speed of about K x A2/A1, or a linear velocity of about V x A2/A1, and thereby reproduce or record and reproduce information of plural signals, or reproduce or record and reproduce information of plural compression rates by one unit. It is also intended to digitize a first signal, reproduce or record and reproduce the digital information compressed in band up to a specified bit rate A1 in n optical channels, digitize a second information, reproduce or record and reproduce the digital information compressed in band up to a specified bit rate A2 in about n x A2/A1 optical channels, and thereby reproduce or record and reproduce information of plural signals, or reproduce or record and reproduce information of plural compression rates by one unit without notably varying the rotating speed or linear velocity. It is further intended to enter the light emitted from a semiconductor laser into a nonlinear optical device (SHG), and reproduce the information on a disk surface or record and reproduce the information on a disk surface by the secondary harmonics delivered from the nonlinear optical device.

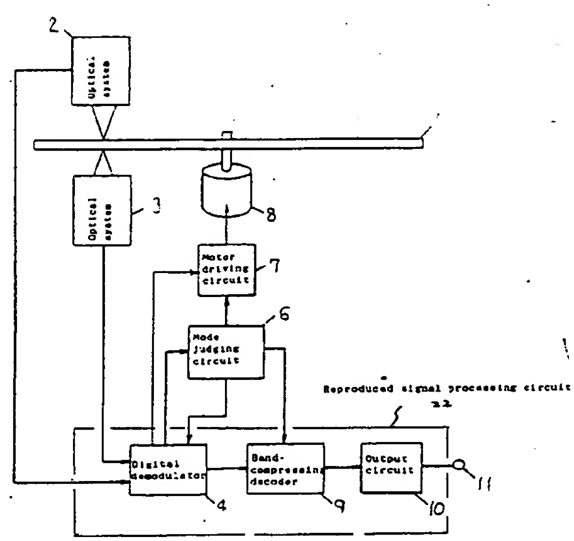

Fig. 1

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The present invention relates to an optical disk apparatus capable of reproducing or both recording and reproducing of signals which are greatly different in the frequency band from each other, such as an NTSC signal and a high definition television signal.

Optical disk apparatuses capable of reproducing or both recording and reproducing one of an NTSC signal and a high definition television signal have been distributed and reported hitherto. However, all of them are of analog recording type and optimally designed for individual signal bands, so that they are not compatible to each other. In the case of digital recording, the quantity of information is by far greater than that in the analog recording. So, it was not realistic to employ the digital recording in the aspects of reduction recording and reproducing time and extension of transfer rate. In other words, there was no optical disk apparatus capable of reproducing or both recording and reproducing both the NTSC signal and the high definition television signal. Even in case that the recording signals are of the same type, there was no optical disk apparatus capable of reproducing or both recording and reproducing in both of a low-definition, long-playing mode at a high compression rate and a high-definition, short-playing mode at a low compression rate.

It is hence a primary object of the invention to provide a high recording density optical disk apparatus capable of reproducing or both recording and reproducing both a narrow band signal such as an NTSC signal and a aide band signal such as a high definition television signal, and capable of reproducing a signal in plural modes including a low-definition, long-playing mode at a high compression rate and a high-definition, short-playing mode at a low compression rate. Another object of the invention is to extremely raise the recording density by inserting a nonlinear optical device (SHG) into an optical system for reproducing or both recording and reproducing a signal by using secondary harmonics.

To achieve the above objects, in one aspect of the present invention, an optical disk apparatus is configured to digitize a first signal, and reproduce or both record and reproduce a digital data compressed in band down to a specified bit rate A1 at a specified disk rotating speed K or a specified linear velocity V, and, on the other hand, digitize a second signal, and reproduce or both record and reproduce a digital data compressed in band down to a specified bit rate A2 at a disk rotating speed of substantially K x A2/A1 or a linear velocity of substantially V x A2/A1. With this configuration, it is possible to reproduce or both record and reproduce any one of plural signals which are different from each other in frequency band or compression rate.

In another aspect of the present invention, an optical disk apparatus is configured to digitize a first signal, and reproduce or both record and reproduce a digital data compressed in band down to a specified bit rate A1 in n optical channels, and, on the other hand, digitize a second signal, and reproduce or both record and reproduce a digital data compressed in band down to a specified bit rate A2 in substantially n x A2/A1 optical channels. With this configuration, it is possible to record and/or reproduce any one of plural signals which are different from each other in frequency band or compression rate without notably varying the disk rotating speed or linear velocity.

In still another aspect of the present invention, an optical disk apparatus may be configured to enter a light emitted from a semiconductor laser into a nonlinear optical device (SHG), and reproduce data recorded on a disk surface or both record data onto and reproduce data from the disk surface by secondary harmonics outputted from the nonlinear optical device. With this configuration, it is possible to extremely increase the recording density.

Fig. 1 is a block diagram of a reproducing system of an optical disk apparatus of the invention,

Fig. 2 is a block diagram of a recording system of an optical disk apparatus of the invention,

Fig. 3 is an example of a disk of the invention,

Fig. 4 is a block diagram of an optical system of an optical disk apparatus of the invention, and

Fig. 5 is a diagram showing a relation of signal, mode and other parameters in an embodiment of the invention.

Fig. 1 is an embodiment of a reproducing system of an optical disk apparatus of the invention. Information recorded on an optical disk 1 is read by an optical systems 2 and 3 including an optical head, and is sent into a digital demodulator 4. In the digital demodulator 4, the information is demodulated into a digital signal, and error correction or other processing is done at the same time. In a mode judging circuit 6, the type and mode of the signal of the reproduced information are judged from the information from the digital demodulator 4.

The output of the digital demodulator 4 is decoded by a band-compressing decoder 9 on the basis of the information from the mode judging circuit 6. The signal decoded and expanded in band is digital-to-analog (D/A) converted in an output circuit 10, and delivered to an output terminal 11. A motor driving circuit 7 for controlling a motor 8 controls the motor 8 depending on the information from the digital demodulator 4 and mode judging circuit 6 so that the disk rotating speed or the linear velocity of the optical head relative to the disk becomes a specified value.

A reproduced signal processing circuit 22 is composed of the digital demodulator 4, band-compressing decoder 9, and output circuit 10.

If, meanwhile, the transfer rate is low, only one channel optical system 2 may be used, and the optical system 3 may be omitted.

Here, the operation of the mode judging circuit 6

is to control the motor 8 so that the linear velocity of the optical head relative to the disk becomes a specified value. Or it is to operate only a required channel of the optical system, which may be realized, for example, by selecting only the necessary information out of the input information in the digital demodulator 4.

In the case of a reproducing only machine, it is sufficient with the reproducing system described above, but in the case of a recording and reproducing machine, a recording system is also needed. Referring then to Fig. 2, an embodiment of a recording system of an optical disk apparatus is explained. The common blocks as in Fig. 1 are identified with the same reference numbers.

A signal entered from an input terminal 15 is analog-to-digital (A/D) converted in an input circuit 16, and is encoded to a specified bit rate signal by a band-compressing encoder 17. This result is fed into a digital modulator 19 to be subjected to processing such as addition of error correction code, and is digitally modulated. Laser beams generated in optical systems 20, 21 are modulated by the digital modulated signal, so that digital information is recorded on an optical disk 1. A motor 8 is controlled by a motor driving circuit 7 so as to achieve a specified rotating speed of the disk or a specified linear velocity of the optical head relative to the disk. A recorded signal processing circuit 23 is composed of the input circuit 16, band-compressing encoder 17, and digital modulator 19.

All of the motor driving circuit 7, digital modulator 19, and encoder 17 are controlled by the information from a mode specifying circuit 18 so as to operate as specified. If it is enough with the operation of one channel of optical system in low transfer rate application, the optical system 21 is not needed.

The mode specifying circuit 18 is to specify the mode by means of, for example, a switch operated by an operator.

As the mode judging method in the mode judging circuit 6 in reproduction, various methods may be considered including a method of, as shown in Fig. 3, recording a coded mode signal on a reference position of the disk, for example, a position on each track on a specific line in the radial direction, and judging the mode by reproducing the mode signal from the reference position.

The optical systems 2, 3, 20, 21 are shown in detail in Fig. 4.

The optical system comprises a semiconductor laser 30, coupling lenses 31, 32, a nonlinear optical device (SHG) 32, a long wavelength cut filter 34, a beam splitter 35, an objective lens 36, a detector 38, and a laser driving circuit 37. In recording, the modulation signal is fed into the laser driving circuit 37. In reproducing, a reproduced signal is delibered from the detector 38.

By inserting the SHG 32, the laser wavelength becomes 1/2, so that the recording density on the disk can be increased about four times. As the SHG 32, the waveguide type is desired when recording and reproducing, but when reproducing only, it may be either waveguide type or bulk type.

Fig. 5 shows an example of reproducing or recording and reproducing plural signals having different bands at plural compression rates, by using thus composed optical disk.

This is to show the relationship of the linear velocity, number of optical system channels and reproduction time in CLV, and the relationship of the disk rotating speed, number of optical system channels and reproduction time in CAV, when the narrow band, NTSC signal is compressed in band to 5 Mbps and 10 Mbps, and when the wide band, high definition television signal is compressed in band to 30 Mbps and 60 Mbps.

In Fig. 5A, the linear velocity is constant, and in Fig. 5B, the disk rotating speed is constant. Supposing, in Fig. 5A, the linear velocity at NTSC signal of 5 Mbps to be V and the reproduction time to be $12T_1$, the linear velocity at HD signal of 30 Mbps is 3V in a two-channel optical system, or 6V in a one-channel optical system, and the reproduction time is respectively $2T_1$. The same holds true in Fig. 5B where the disk rotating speed is constant.

In the same signals, the greater the bit rate after band compression, the shorter becomes the reproduction time and hence a picture of high quality is reproduced.

In the foregoing embodiments, the reproducing system and recording system are explained separately, but the invention is similarly applied either in the optical disk apparatus for recording and reproducing by one unit or in the optical disk apparatus for reproducing only.

Incidentally, the narrow band signals include the NTSC signal, PAL signal, SECM signal and so on, and the wide band signals include HD signal, HDMAC signal, MUSE signal and the like.

Input and output signals may include, among others, composite signals, Y, PrPb, R, G, B, YC signals, audio signals, and control signals.

The mode judging circuit 6 may be designed to set by the operator by using a switch.

The optical system is not limited to two channels, but the number of channels may be increased as required.

The invention is valid not only in the CAV system and CLV system, but also in the MCAV system, MCLV system, and other disk driving systems.

Claims

1. An optical disk apparatus comprising:

optical means for reproducing or recording and reproducing digital information from a disk recording medium;

recording signal processing means for converting and processing an input signal into a digital signal when recording;

reproduced signal processing means for converting and processing a reproduced digital signal into an output signal when reproducing;

disk rotating means possessing a first mode for digitizing a first signal, and reproducing, or recording and reproducing the digital information compressed in band up to a specified bit rate A1, at a specified rotating speed K or a specified linear velocity V;

disk rotating means possessing a second mode for digitizing a second signal, and reproducing, or recording and reproducing the digital information compressed in band up to a specified bit rate A2, at a rotating speed of about K x A2/A1 or a linear velocity of about V x A2/A1;

mode specifying means for specifying to select either the first or second mode, as the disk rotating mode, when recording; and

mode judging means for judging to select either the first or second mode, as the disk rotating mode, when reproducing by information from a reproducing disk.

2. An optical disk apparatus of claim 1, wherein the first signal is NTSC signal, PAL signal or SECAM signal, and the second signal is a high definition television signal having a wider frequency band than that of the first signal or a compressed signal of the high definition television signal.

3. An optical disk apparatus of claim 1, wherein the first signal and second signal are the same in kind, and different from each other in compression rate.

4. An optical disk apparatus of claim 1, wherein a light emitted from a semiconductor laser is entered into a nonlinear optical device (SHG), and the information on the recording medium is reproduced, or the information is recorded on or reproduced from the recording medium by secondary harmonics delivered from the nonlinear optical device.

5. An optical disk apparatus comprising:

disk rotating means for rotating a disk recording medium at a specified rotating speed K or a specified linear velocity V;

recording signal processing means for converting and processing an input signal into a digital signal when recording;

reproduced signal processing means for converting and processing a reproduced digital signal into an output signal when reproducing;

optical means possessing a first mode for digitizing a first signal, and reproducing or recording and reproducing the digital signal compressed in band up to a specified bit rate A1, in n optical channels;

optical means possessing a second mode for digitizing a second signal, and reproducing or recording and reproducing the digital information compressed in band up to a specified bit rate A2, in about n x A2/A1 optical channels;

mode specifying means for specifying to select either the first or second mode, as the optical means, when recording; and

mode judging means for judging to select either the first or second mode, as the optical means, when reproducing by the information from the reproducing disk.

6. An optical disk apparatus of claim 5, wherein the first signal is NTSC signal, PAL signal or SECAM signal, and the second signal is a high definition television signal having a wider signal band than that of the first signal or a compressed signal of the high definition television signal.

7. An optical disk apparatus of claim 5, wherein the first signal and second signal are the same in kind, and different from each other in compression rates.

8. An optical disk apparatus of claim 5, wherein a light emitted from a semiconductor laser is entered into a nonlinear optical device (SHG), and information on the recording medium is reproduced, or the information is recorded on or reproduced from the recording medium by secondary harmonics delivered from the nonlinear optical device.

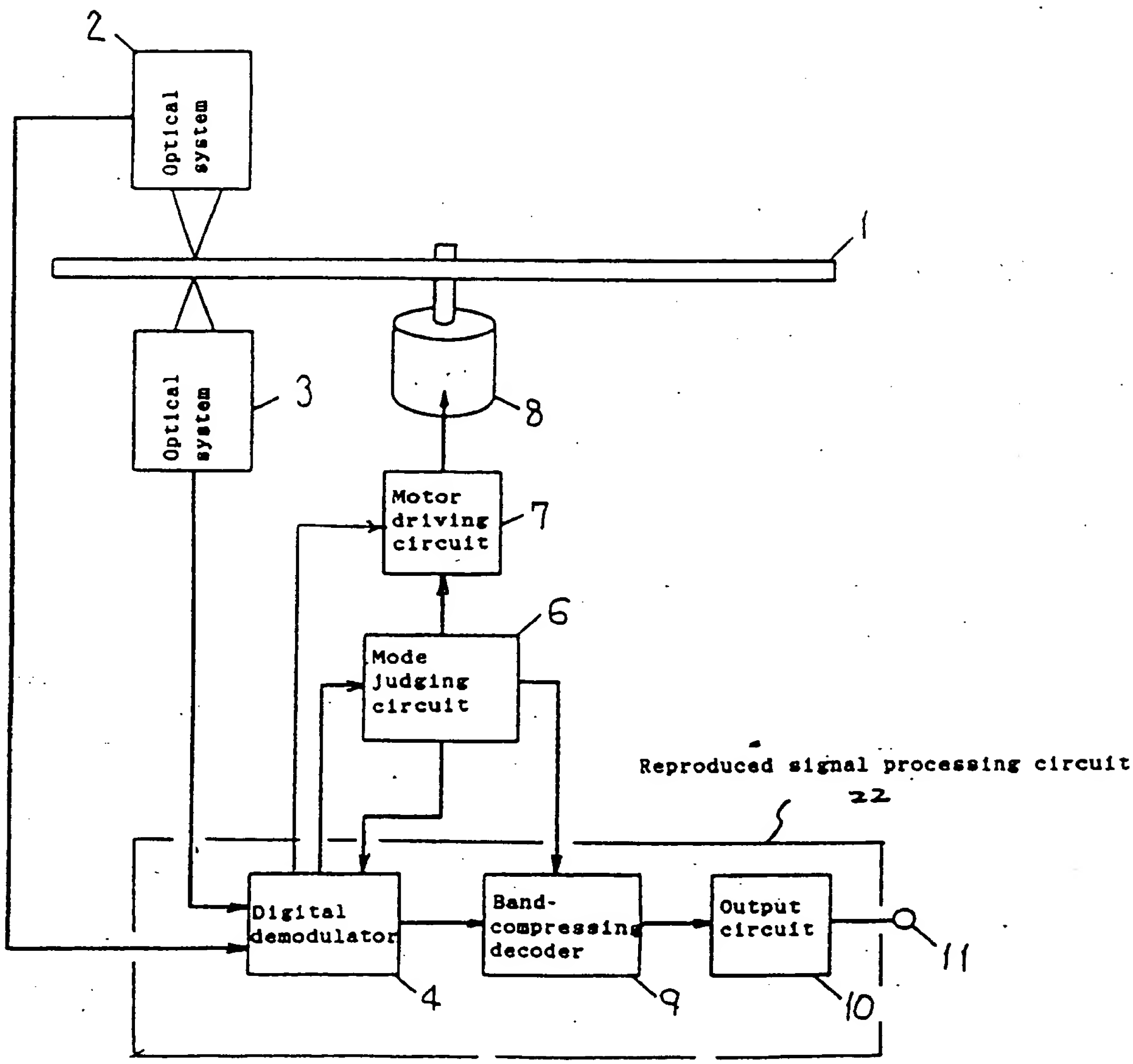
2
Optical system
1
Optical system
3
8
Motor driving circuit
7
6
Mode judging circuit
Reproduced signal processing circuit
22
Digital demodulator
Band-compressing decoder
Output circuit
4
9
10
11

Fig. 1

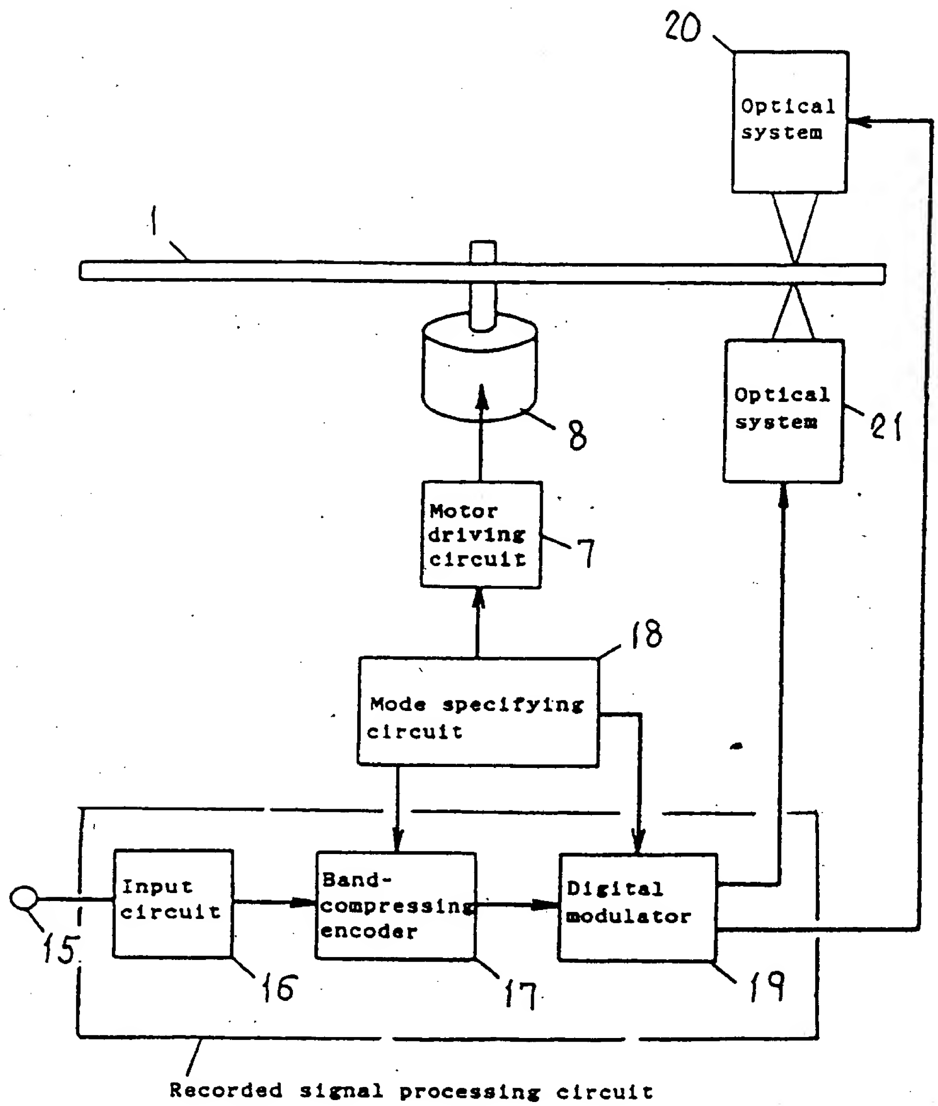
20
Optical system
1
8
Optical system
21
Motor driving circuit
7
18
Mode specifying circuit
Input circuit
Band-compressing encoder
Digital modulator
15
16
17
19
Recorded signal processing circuit

Fig. 2

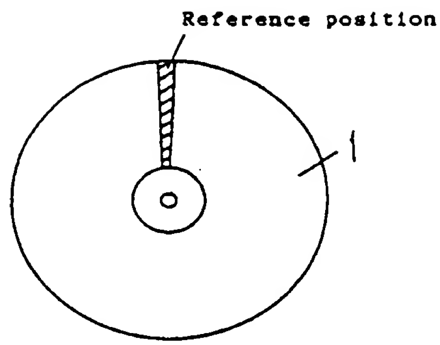
Reference position
1

Fig. 3

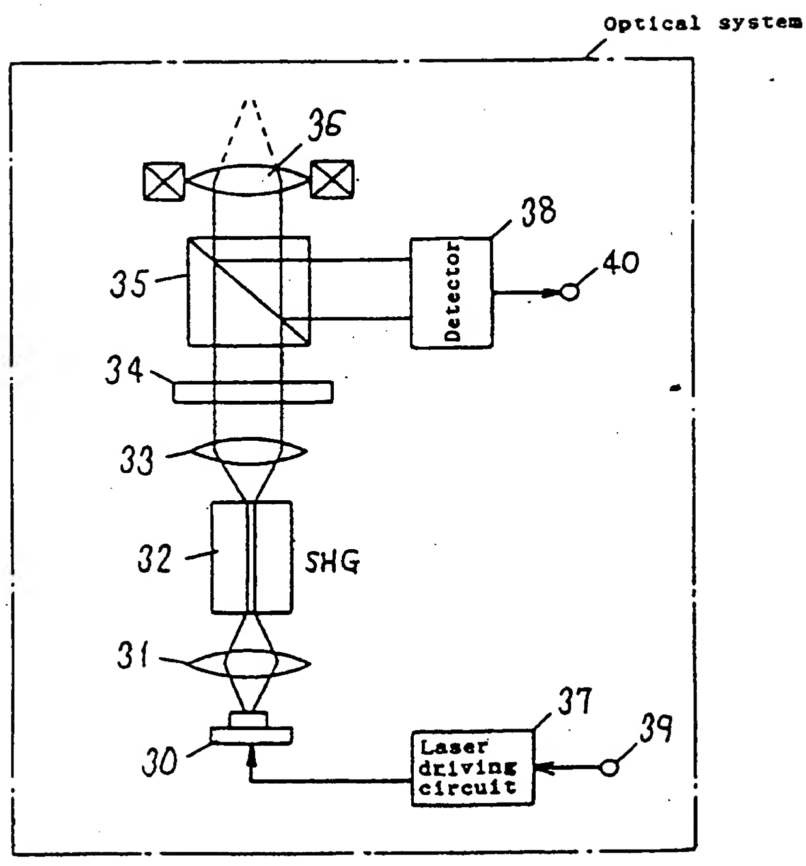
Optical system
36
38
Detector
40
35
34
33
32
SHG
31
37
39
Laser
driving
circuit
30

Fig. 4

(A)

Signal	Bit rate after band compression (Mbps)	Linear velocity	No. of optical system channels	Time
NTSC	5	V	1	$12 T_1$
	10	V	2	$6 T_1$
		2 V	1	$6 T_1$
HD	30	3 V	2	$2 T_1$
		6 V	1	$2 T_1$
	60	6 V	2	T_1

(B)

Signal	Bit rate after band compression (Mbps)	Rotating speed	No. of optical system channels	Time
NTSC	5	K	1	$12 T_2$
	10	K	2	$6 T_2$
		2 K	1	$6 T_2$
HD	30	3 K	2	$2 T_2$
		6 K	1	$2 T_2$
	60	6 K	2	T_2

Fig. 5